REMARKS

Claims 1-2, 5-12, 14, and 17-19 are pending in the application. Independent claim 1 is amended to include features of dependent claims 3 and 4 and features from the original specification as filed, including features from the Example on page 5. Independent claim 8 is amended to include features of dependent claim 16 and features from the original specification as filed, including features from the Example on page 5. Independent claim 14 is amended to include features from the original specification as filed, including features from the Example on page 5. Claims 3, 4, 13, and 16 are currently cancelled and claim 15 was previously cancelled. Claims 17-19 are new and include features from the original specification as filed, including features from the Example on page 5.

The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

1. REJECTION UNDER 35 U.S.C. § 112

Claim 13 stands rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

Applicant has cancelled Claim 13 thereby rendering the rejection moot. Withdrawal of the rejection is respectfully requested.

2. REJECTION UNDER 35 U.S.C. § 102

Claims 1-14 stand rejected under 35 U.S.C. § 102(b) as allegedly anticipated by Strangman et al (U.S. Pat. No. 5,015,502). The rejection is respectfully traversed.

Strangman cannot anticipate the present claims as the document fails to disclose an outer zirconia coating applied directly to an aluminum-containing metallic oxidation protection coating on a metallic component. See *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) (each and every element in the claim must be present in the reference for the claim to be anticipated).

Amended claim 1 is drawn to a method of preventing rumpling of metallic components. Specification page 3, lines 6-8. A ceramic coating based on ZrO_2 having a thickness of less than 50 μm is applied to a metallic component whereby the ceramic coating forms an exposed outer layer. Specification page 3, lines 9-11; page 4, lines 18-19. The metallic component being coated has an aluminum-containing metallic oxidation protection coating to which the ceramic coating is applied. Specification page 4, lines 14-17; page 5, lines 11-13. Amended independent claims 8 and 14 also include a ceramic coating comprising zirconia applied directly to an aluminum-containing metallic oxidation protection coating. For example, the aluminum-containing metallic oxidation protection coating can comprise NiCoCrAlY, as illustrated in the Example on page 5 and in dependent claims 17-19.

In contrast, the Strangman document discloses applying a thermal barrier coating (15), such as a columnar grained ceramic (e.g., zirconia), to an underlying high purity, dense, CVD alpha alumina layer (14). Strangman col. 5, lines 9-11 and 15-20; and see Figure 1. The CVD alpha alumina layer is not an aluminum-containing metallic oxidation protection coating, as per the present claims. The aluminum-containing metallic oxidation protection coating contains aluminum as part of the metallic oxidation protection coating, but the high purity, dense, CVD alpha alumina layer in Strangman is essentially all alumina, which is recognized by a skilled

artisan as not an aluminum-containing metallic oxidation protection coating. Strangman, col. 5, lines 9-11.

In Strangman, the alpha alumina layer (14) is deposited onto a MCrAlY surface. For example, a MAR.M247 superalloy substrate (11) is coated with NiCoCrAlY bond coating (13), having a thin, thermally grown interfacial aluminum oxide scale (14) on its surface, covered by a columnar grained, 8-20 percent yttria stabilized zirconia insulative layer (15). Strangman col. 6, lines 63-68; Figure 1. Thus, the Strangman document discloses an outer layer of zirconia applied to the CVD alpha alumina layer, not to a layer of aluminum-containing metallic oxidation protection coating.

Accordingly, Strangman is not an anticipatory document and Applicants request reconsideration of the claims and withdrawal of the rejection.

3. Rejection Under 35 U.S.C. § 102

Claims 1-4, 6-9, 13-14 and 16 stand rejected under 35 U.S.C. § 102(b) as allegedly anticipated by Ulion et al (U.S. Pat. No. 5,262,245). The rejection is respectfully traversed.

Features of independent claims 1, 8, and 14 are presented above.

In contrast to the present claims, the Ulion document discloses an oxide stabilized ceramic coating on a thin, adherent aluminum oxide scale on the substrate surface. Ulion abstract. For example, an unfocused beam of electrons is impinged onto the target while bleeding a small but controlled amount of oxygen into the coating chamber. The beam heats the target to a temperature below that at which vaporization takes place, and heat radiated by the target causes the substrate surface to be oxidized due to the presence of oxygen in the chamber, and selectively form the adherent, thin alumina scale. Ulion col. 5, lines 48-57. The scale is

accordingly called a thermally grown scale. Ulion col. 5, line 58. Next a vaporized ceramic such as yttria stabilized zirconia is condensed onto the alumina scale. Ulion col. 5, lines 63-67.

A key feature of the Ulion document is the presence of the thin, adherent aluminum oxide scale on the surface of the substrate, where the ceramic coating is present on the surface of the scale. Ulion abstract; col. 3, lines 50-52. The Ulion document states that tests show the bond strength between the scale and the substrate surface has the greatest effect on the overall properties on the ceramic coating system and the adherent scale formed according to Ulion produces a coating system with markedly improved oxidation resistance. Ulion col. 3, lines 53-58. This aluminum oxide scale is not an aluminum-containing metallic oxidation protection coating, as per the present claims, as the scale is all aluminum oxide. Thus, Ulion does not disclose an outer layer of ceramic coating comprising zirconia applied onto an aluminum-containing metallic oxidation protection coating and cannot anticipate the present claims.

Applicants request reconsideration of the claims and withdrawal of the rejection.

4. REJECTION UNDER 35 U.S.C. § 103

Claim 9 stands rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Ulion et al (U.S. Pat. No. 5,262,245) in view of Stolle et al (U.S. Pat. No. 6,737,110).

Claim 9 is drawn to a process including a coating produced by electron beam physical vapor deposition (EB-PVD) or air plasma spraying (APS). Claim 10 is drawn to a process produced by chemical vapor deposition (CVD), electrophoresis followed by microwave sintering, or dip coating with ceramic precursors followed by sintering. The Examiner's comments in the rejection are directed toward CVD, thus it is Applicants' view that the present rejection is intended to be applied to claim 10 instead of claim 9. If the Examiner intended

otherwise, Applicants respectfully request clarification. The following comments are hence directed toward chemical vapor deposition as provided by claim 10.

Combination of Ulion and Stolle cannot establish a case of obviousness as these documents fail to disclose all the features of the presently claimed methods, namely the application of an outer layer of ceramic coating comprising zirconia directly onto an aluminum-containing metallic oxidation protection coating. Instead, the Ulion document necessarily applies zirconia to a thin, adherent aluminum oxide scale. Moreover, there is no reason provided as to why a skilled artisan would modify these documents in order to eliminate the aluminum oxide scale or substitute it with an aluminum-containing metallic oxidation protection coating. The aluminum oxide scale is a key feature of Ulion and there is no reason to replace or forgo the scale. Further, it is not clear whether the electron beam coating method used to apply the scale and ceramic layer as per Ulion could be adapted to a chemical vapor deposition process, as per Stolle.

As described above, the Ulion document applies a ceramic coating (e.g., zirconia) to a thin, adherent aluminum oxide scale on the surface of the substrate, not to a layer of an aluminum-containing metallic oxidation protection coating; aluminum oxide scale is not an aluminum-containing metallic oxidation protection coating. The presence of a thin, adherent aluminum oxide scale on the surface of the substrate, where the ceramic coating is present on the surface of the scale, is a key feature of Ulion. The bond strength between the scale and the substrate surface has the greatest effect on the overall properties on the ceramic coating system and the adherent scale produces a coating system with markedly improved oxidation resistance. Ulion col. 3, lines 53-58. The adherent scale as well as the ceramic thermal barrier coating is applied using an EB-PVD process. Ulion col. 5, lines 38-62.

The Stolle document describes thermal barrier coatings (e.g., zirconium oxide) applied using chemical vapor deposition. Stolle col. 2, lines 15-28. Stolle is silent with respect to applying an outer layer of ceramic coating comprising zirconia onto an aluminum-containing metallic oxidation protection coating. Stolle describes that a thermal barrier coating can be produced by chemical vapor deposition to form a thermal barrier coating 1 (having a columnar structure 2) on an adhesion layer 3. Stolle figure 1; col. 3, lines 7-20. The adhesion layer 3 may be an aluminum diffusion layer, a platinum/aluminum diffusion layer, or an MCrAlY cladding layer. Stolle col. 3, lines 20-23.

In view of the combined disclosures, there is no apparent reason for a skilled artisan to modify the Ulion and Stolle documents by eliminating the aluminum oxide scale layer to which the ceramic coating is applied in Ulion, and such a reason is a requisite for a case of obviousness. See *KSR Int'l Co. v. Teleflex Inc.,* 550 U.S. 398, 418, 82 USPQ2d 1385, 1396 (2007) (obviousness includes determining whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue). In fact, the Stolle document also contemplates applying the thermal barrier coating to aluminum containing layers which only reinforces retaining the adherent aluminum oxide scale. There is no basis in the cited documents or the general knowledge in the art as to why a skilled artisan would eliminate this key feature from Ulion when combining these documents and instead apply an outer layer of ceramic coating comprising zirconia onto an oxidation protection coating comprising an aluminum-containing metallic oxidation protection coating, as per the present claims. It is counter to obviousness to modify or forgo this requisite functional aspect of the adherent scale. See *Eisai Co. Ltd. v. Dr. Reddy's Labs, Ltd.*, 87 USPQ2d 1452, 1457 (Fed. Cir. 2008) (no case for obviousness when the

record lacks any discernible reason to start with the lead compound only to drop the very feature that gave it its advantageous property).

What is more, when formulating a *prima facie* case of obviousness, a reasonable expectation or predictability of success is required, as noted in MPEP § 2143.02 and in *KSR v. Teleflex*, 550 U.S. 398, 82 USPQ2d 1385, 1396 (2007): "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the results would have been predictable to one of ordinary skill in the art." It is not clear how the electron beam physical vapor deposition (EB-PVD) used to form the adherent aluminum oxide scale as well as the ceramic thermal barrier coating in Ulion could be replaced with chemical vapor deposition, as per Stolle. It is not predictable whether this different application process can achieve the key feature of Ulion - the presence of the thin, adherent aluminum oxide scale on the surface of the substrate, where the ceramic coating is present on the surface of the scale. For example, in Ulion, an oxygen stream is fed into the into the coating chamber while the electron beam heats the target and causes the substrate surface to oxidize due to the presence of oxygen and selectively form the adherent, thin alumina scale. Ulion col. 5, lines 48-62. The oxide scale further grows during while the ceramic vapors condense on the scale. Ulion col. 5, lines 63-67. Thus, it is not predictable that switching the EB-PVD based process to a CVD based process will produce the same effects with the same oxidation resistance. Ulion col. 3, lines 52-58.

The present claims also provide unexpected results when compared to the combination of Ulion and Stolle. Thick ceramic layers from 100-200 μm to several millimeters are used as heat insulation layers on turbine blades. Present specification page 2, lines 15-19. These thick ceramic layers prevent thermally influenced wrinkling. Specification page 2, lines 19-20. However, there are cases where the application of heat insulation layers to metallic surfaces is

precluded as they would impede heat dissipation or adversely affect function of the component due to the additional mass or geometry. Specification page 2, lines 20-24.

In the present case, a ceramic coating comprising zirconia (up to 30 μm thick for claim 10) applied onto an oxidation protection coating comprising an aluminum-containing metallic oxidation protection coating (e.g., NiCoCrAlY) is suitable for metallic components which are subjected to high mechanical stress or hydrodynamic stress and high thermal stress, especially when the thermal stress is cyclic in nature. Specification page 5, lines 4-6. Although the ceramic coating has substantially no heat-insulating effect due to its low layer thickness, an effect against thermally influenced wrinkling (rumpling) is observed. Specification page 3, lines 18-21. This is surprising and unexpected as compared to the thick ceramic layers typically used to prevent thermally influenced wrinkling.

In contrast, the combination of Ulion and Stolle fails to appreciate these aspects. The Ulion document instead provides improved oxidation resistance (via the adherent aluminum oxide scale layer to which the ceramic layer is applied) that results in improved thermal barrier properties, which is the primary object of the Ulion document. Ulion col. 3, lines 55-60. The document combination fails to address rumpling and further fails to address rumpling in the manner presently claimed.

Applicants respectfully request reconsideration of the claim and withdrawal of the rejection.

5. REJECTION UNDER 35 U.S.C. § 103

Claims 11-12 stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Ulion et al (U.S. Pat. No. 5,262,245).

The shortcomings of the Ulion document are illustrated above. Briefly, a key feature and primary object of the Ulion document is the presence of a thin, adherent aluminum oxide scale on the surface of the substrate, where the ceramic coating is present on the surface of the scale. Ulion abstract; col. 3, lines 50-60. The Ulion document asserts that tests show the bond strength between the scale and the substrate surface has the greatest effect on the overall properties on the ceramic coating system and the adherent scale produces a coating system with markedly improved oxidation resistance. Thus, Ulion does not disclose an outer layer of ceramic coating comprising zirconia applied onto an oxidation protection coating comprising an aluminum-containing metallic oxidation protection coating and cannot establish a *prima facie* case of obviousness. See *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

There is also no apparent reason for a skilled artisan to modify the Ulion document by eliminating the aluminum oxide scale layer to which the ceramic coating is applied in Ulion. There must be a reason or basis for such action in order to establish a case of obviousness. As it stands, it is counter to obviousness to modify or forgo the requisite functional aspect of the adherent scale, as the improved oxidation resistance and improved thermal barrier properties resulting from the adherent scale layer form the primary object of the Ulion document.

Applicants respectfully request reconsideration of the claim and withdrawal of the rejection.

6. Rejection Under 35 U.S.C. § 103

Claims 1-14 and 16 stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Rigney et al (U.S. Pat. No. 6,455,167) in view of Strangman et al (U.S. Pat. No. 5,015,502) and Ulion et al (5,262,245).

The present claims are not obvious over the combination of Rigney, Strangman, and Ulion as these documents fail to disclose the application of an outer layer of ceramic coating comprising zirconia that is less than 50 µm or up to 30 µm onto an oxidation protection coating comprising aluminum-containing metallic oxidation protection coating (e.g., NiCoCrAlY). Further, there is no apparent reason provided in the cited documents or based on the general knowledge in the art as to why a skilled artisan would modify the collective document disclosures in a manner that recreates the present claims.

The Rigney document describes a coating for use on a superalloy substrate. As illustrated in Rigney figure 4, an airfoil 30 includes a superalloy substrate 32 that is overlaid with a tightly adherent, thin ceramic diffusion barrier layer 33. Rigney col. 5, lines 3-16. Overlaying the diffusion barrier layer 33 is a coating 34 having a high concentration of alumina, such as an MCrAlX coating, where M includes nickel, cobalt, or combinations thereof and X includes yttrium. Rigney col. 5, lines 16-18; col. 1, lines 26-34. The coating 34 can be overlaid with a ceramic topcoat 36, typically 7YSZ, which is applied as a thermal barrier coating. Rigney col. 5, lines 21-24. Rigney fails to describe any thickness for the ceramic topcoat 36, much less a ceramic coating comprising zirconia that is less than 50 µm (present independent claims 1 and 14) or up to 30 µm (present independent claim 8).

Details of the Strangman and Ulion documents are illustrated in the preceding sections, each are briefly summarized as follows.

Strangman applies a thermal barrier coating, such as a columnar grained ceramic (e.g., zirconia), to an underlying high purity, dense, CVD alpha alumina layer. The alpha alumina layer is deposited onto a MCrAlY surface so that the alpha alumina layer is between the ceramic

layer and MCrAlY surface. Strangman discloses that the thickness of the ceramic layer may vary from 1 to 1000 microns. Strangman col. 6, lines 2-5.

Ulion discloses a thin, adherent aluminum oxide scale on the surface of the substrate, where the ceramic coating is present on the surface of the scale. The thickness of the ceramic coating can range from about 25 to 500 microns. Ulion col. 6, lines 14-18.

With respect to independent claims 1, 8, and 14, the rejection alleges that a skilled artisan would take the coating according to Rigney and would vary the thickness of the ceramic layer according to Strangman or Ulion. It is alleged that the thickness of the ceramic coating is a result effective variable and would be adjusted depending on the amount of protection. Office Action dated September 3, 2009, page 7, lines 14-20. However, the thickness in the Strangman and Ulion documents is varied according to its use in thermal barrier applications. Strangman col. 6, lines 2-5; Ulion col. 6, lines 14-15. This is in contrast to the present claims.

The present claims provide unexpected results in providing rumpling/wrinkling resistance as the presently claimed ceramic layer thicknesses have little, if any, heat-insulating effect. Thick ceramic layers from 100-200 μm to several millimeters are typically used as heat insulation layers on turbine blades. Present specification page 2, lines 15-19. These thick ceramic layers prevent thermally influenced wrinkling. Specification page 2, lines 19-20. However, there are cases where the application of heat insulation layers to metallic surfaces is precluded as they would impede heat dissipation or adversely affect function of the component due to the additional mass or geometry. Specification page 2, lines 20-24.

In the present case, a ceramic coating comprising zirconia (less than 50 μm thick for claims 1 and 14, or up to 30 μm thick for claim 8) applied onto an aluminum-containing metallic oxidation protection coating (e.g., NiCoCrAlY) is suitable for metallic components which are

subjected to high mechanical stress or hydrodynamic stress and high thermal stress, especially when the thermal stress is cyclic in nature. Specification page 5, lines 4-6. Although the ceramic coating has substantially no heat-insulating effect due to its low layer thickness, an effect against thermally influenced wrinkling (rumpling) is observed. Specification page 3, lines 18-21. This is surprising and unexpected as compared to the thick ceramic layers typically used to prevent thermally influenced wrinkling.

Thus, the present claims are counterintuitive to cases where thickness is varied according to the use in thermal barrier applications. In particular, Strangman and Ulion vary the thickness in response to the need for thermal resistance, with greater thickness imparting greater heat resistance. In contrast, the present claims use a thin layer providing substantially no heat-insulating effect but yet provide an effect against thermally influenced wrinkling (rumpling).

If anything, the optimization of the thickness of the thermal barrier coating in view of Strangman and Ulion suggests greater thickness for providing an increased thermal barrier to prevent spalling. It is surprising and unexpected that a coating resistant to wrinkling (rumpling) could be achieved by using the thin layers of ceramic as presently claimed. A skilled artisan would not expect such a result and such a result is not predictable in view of the combination of Rigney, Strangman, and Ulion.

The rejection based on the combined documents appears to be using the "obvious to try" standard in applying and combining the reference teachings. This standard has been sanctioned by *KSR Int'l Co. v. Teleflex Inc.,* 550 U.S. 398, 82 USPQ2d 1385, 1396 (2007), but with the proviso that there has to be "a finite number of identified, *predictable* solutions" (emphasis added). Furthermore, "[t]he combination of familiar elements according to known methods is likely to be obvious *when it does no more than yield predictable results*." *Id.*, emphasis added.

"The operative question in this 'functional approach' is thus 'whether the improvement is more than the predictable use of prior art elements according to their established functions.'" *Ex Parte Smith*, Appeal No. 2007-1925 (Bd. Pat. App. & Int. June 25, 2007) quoting *KSR* at 1740.

Here, it could not have been predicted by a person of ordinary skill in the art that the presently claimed thin layer of ceramic applied onto an oxidation protection coating comprising an aluminum-containing metallic oxidation protection coating could prevent thermally influenced wrinkling (rumpling). Accordingly, the present claims are not obvious in view of the combination of documents.

Applicants respectfully request reconsideration of the claim and withdrawal of the rejection.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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